FUEL GUIDANCE, by Tom Gahs

DIFFERENCES BETWEEN FUELS

This article is the first of a series that presents practical information on shipboard fuel use. Differences between fuel types will be discussed in this initial article. Future topics will include: the Coast Guard's shipboard fuel sampling program, fuel stability, husbandry practices, and what to do when a shipboard fuel problem occurs.

There are many fuels commercially available both throughout the country and around the world. Fuels can have widely varying characteristics - but not all are suitable for use on Coast Guard vessels. Knowing the type of fuel you've taken onboard is also essential to good fuel management. Unfortunately, locally used fuel names often have no real meaning and may even be incorrect. For instance, "F-76" is sometimes mistakenly used to represent any commercial distillate marine fuel. Misuse of the fuel's name can result in serious shipboard problems. Recently, a cutter had to deal with a severe fuel storage stability problem. The unstable fuel had to be off-loaded and the tanks cleaned. The primary cause for this problem was incorrect identification of the fuel as "F-76" by the supplier. F-76 is a specific MIL-SPEC fuel product that, as part of its spec requirements, must pass a rigorous storage stability test. However, no commercial fuel products come with a similar storage stability "guarantee". All commercial fuel therefore must be periodically rotated onboard ship - so that it's consumed before any potential stability problem can occur. Because the cutter personnel thought they had loaded F-76, they took the fuel's storage stability for granted. Had they known that they had actually taken onboard a commercial product, they may have been more careful about rotating their fuel stocks - and prevented the problem from occurring.

The Coast Guard has three fuels designated as primary ship propulsion fuels. Two of those products are MIL-SPEC products: **F-76** and **JP-5** (also known as F-44). The third product is a commercial product: Naval Purchase Description Marine Gas Oil (**NPD MGO**). All three fuels are high quality 100% distillate fuels. Any and all other fuels are designated as Emergency Substitute fuels. Emergency Substitute fuels are to be used only when the primary fuels are unavailable and only after confirming their suitability. Your respective MLC (vr) or ELC can assist your in making that determination. Short descriptions of the fuel types you will most likely encounter follow:

JP-5. JP-5 is procured to MIL-DTL-5624T; **Turbine Fuel, Aviation, Grades JP-4, JP-5, and JP-8 ST**. JP-5 is a very clean burning fuel with very strict quality requirements - especially with regard to water and particulate content. Because it's an aviation fuel, it includes a Fuel System Icing Inhibitor (FSII) additive. JP-5 is inherently stable; it does not form oxygenated sludge. Gas turbine maintenance (particularly when associated with combustor cans) is reduced when burning JP-5. The downsides are that JP-5 tends to be more expensive; its energy content is lower than F-76 type fuel; and it may have lower viscosity and/or lubricity characteristics. The lower energy content means higher fuel consumption rates. Lower viscosity and lubricity may cause wear-type problems in diesel engine injection pumps. Due to its lower lubricity, Caterpillar engines require that JP-5 supply temperatures not exceed 100ºF; Volvo-Penta engines require 5% clean lube oil to be mixed with JP-5. JP-5 is approved for unrestricted use on all Coast Guard engines (both gas turbine and diesel). Government sources for JP-5 can be found in NAVPETOFFINST 4025.1E of 30 Sep 1999. This document can be downloaded from www.navpetoff.navy.mil/navpubs.htm.

F-76. F-76 is procured to MIL-F-16884J, **Fuel, Naval Distillate**. It is suitable for use in both gas turbines and diesel engines. F-76 burned in Paxman engines however, must have a minimum Cetane Number of 45 (the F-76 specification allows a minimum Cetane Number of 42). It has numerous and very strict quality requirements - including a storage stability test. True F-76 fuel can generally only be obtained from government bulk fuel sources - a government fuel depot, or an oiler. Locations for F-76 can be found in the same NAVPETOFFINSTR referenced above. As the Navy infrastructure has shrunk, F-76 has been harder for Coast Guard vessels to access (unless you're fortunate enough to be located close to a major Naval base). By far, the majority of fuel burned by the Coast Guard is NPD MGO.

NPD MGO. NPD MGO is a commercial distillate marine fuel, supplied by Defense Energy Support Center (DESC) contractors, which must meet several additional (and more demanding) quality requirements than an open market commercial fuel. However, NPD MGO has considerably fewer and less stringent requirements than F-76. The most operationally significant difference is that there are no storage stability requirements. The Navy has therefore imposed a 6-week use limit on NPD MGO (starting from when the fuel is brought onboard). However, its storage stability is no different than any other commercial marine fuel product. Effective stock rotation is critical for any commercial fuel product - including NPD MGO. NPD MGO is approved for use in all Coast Guard diesel engines. As of this writing, it is not approved for use in the Coast Guard's Pratt & Whitney FT4 gas turbines, but this restriction is expected to be lifted soon. NPD MGO burned in Paxman engines must have a minimum Cetane Number of 45 (the NPD allows a minimum Cetane Number of 42). NPD MGO's domestic national stock number (NSN) is 9140-01-313-7776. The overseas NSN is 9140-01-417-6843. Both domestic and overseas sources can be found at www.desc.dla.mil/main/p/specialt/bunkers/bltngate.htm.

B-76. B-76 is a DESC supplied product that is available only along the Gulf of Mexico. B-76 meets a modified F-76 specification which excludes the storage stability requirement. B-76 should therefore be treated as if it were NPD MGO.

DF2. DF2 is an additional DESC supplied commercial distillate fuel product available in some locations. DF2 has fewer and less restrictive requirements than NPD MGO. It has no storage stability requirements. DF2 also has a minimum flashpoint (52ºC), which is lower than what is required for use on Coast Guard vessels (60ºC). JP-5, F-76, NPD MGO, and B-76 all have minimum flashpoints of 60ºC. Flashpoint is a measure of fuel flammability - that equates to minimally acceptable safety standards for shipboard storage and handling. DF2 should be taken onboard only as an emergency fuel. Its NSN is 9140-01-456-9443.

OPEN MARKET COMMERCIAL PRODUCTS. The quality of open market commercial distillate fuel purchases can vary widely. Open market Emergency Substitute fuels are listed in their preferred order: ASTM D 975 Grade No. 2-D; ASTM D 396 No. 2; ASTM D 2880 No 2-GT; and commercial MGO (100% distillate) from a supplier not under a DESC contract. Typically, however, a local fuel supplier will not be able to quote the specific ASTM or ISO spec that the fuel was made to at the refinery. Generally, they can only supply a local product name - which, as already discussed, may not be all that meaningful. It may be necessary to have the supplier provide a fuel property/analysis report in order to determine if the fuel is suitable for use on your vessel.

It must be noted that some commercial marine distillate fuel blends can contain residual fuel. Residual fuel is high in trace metals (such as vanadium) - which can cause catastrophic damage in gas turbines and/or some high and medium speed diesel engines. Residual fuel also has very high carbon residue levels, which can lead to coking and plugging of fuel nozzles. Even a very slight contamination with residual fuel will cause the distillate fuel product to appear very dark in color, or even black. Residual contamination can almost always be traced to a "house-keeping" problem by the supplier (commingling of distillate product with residual fuel in a tanker barge or truck). Any marine distillate diesel fuel that contains even trace amounts of residual fuel must not be used in Coast Guard engines.

DYE. The MIL-SPEC products JP-5 and F-76 are not dyed. When held up to the light, they will therefore appear clear to light yellow/tan in color. NPD MGO, B-76, DF2, and other domestic (CONUS only) commercial marine distillate fuels will be dyed red for tax purposes. These products will appear pink to red when held up to the light. This gives you an immediate check whether the fuel product delivered to your vessel is really a MIL-SPEC product, or a commercial product that will require periodic stock rotation to minimize any potential storage stability concerns.

Additional information of fuel can be found in the Naval Engineering Manual, COMDTINST M9000.6D, Chapter 541 and the Naval Ships' Technical Manual, S9086-SN-STM-010, Chapter 541, Section 10. Any questions, comments, or suggestions for future articles should be directed Tom Gahs, ELC-026, voice 410-762-6291, fax 410-762-6203, email TGahs@elcbalt.uscg.mil.